Project News

from the Integrated Crop Pollination Project

January 2016
Issue 4

In this issue:

Project ICP is a collaboration between:

AgPollen LLC
Franklin & Marshall College
Loyola University Chicago
Michigan State University
Oregon State University
Pennsylvania State University
Rutgers University
Simon Fraser University
The Xerces Society
UC-Davis
UC-Berkeley
University of Florida
University of Vermont
USDA-ARS Pollinating Insects Lab
Wenatchee Valley College

This project is supported by USDA-NIFA Specialty Crop Research Initiative Grant (#2012-51181-20105)

2015 ICP Research Update (Halfway there!)

As I write this on a snowy January day in Michigan, blueberries in Florida and almonds in California are waking from their winter dormancy, and pollination season will soon start again. This spring season of fieldwork at our Project ICP field sites will mark the fourth year of measurements at most of these farms. Our excellent team has achieved a lot already, but there are also new developments as we pass the halfway point of this five year project. The ability to take consistent assessments across multiple years in hundreds of farm fields is one unique aspect of Project ICP, and it is exciting to see the patterns emerging across regions. We already have thousands of bees collected, identified, and into our project-wide online database, and the research teams are analyzing the first three years of data. These efforts will improve our understanding of which bees are important where, and it's already clear that the situation varies widely across the country even within the same crop. Floral resources are critical for bees, and we now have habitat plantings establishing at farms across our grower network. These will be used to test how wild bees can be enhanced and whether this can boost crop yields through enhanced biodiversity. Using a more targeted approach that employs alternative managed bees such as blue orchard bees or bumble bees could fit some farm settings much better, and we are learning about which flowering plants they will visit when the crop isn't in bloom.

This year the Project ICP extension-outreach team have gone into overdrive, with workshops, videos, and publications, and this group is coordinating with the social scientists who are measuring the impact of our project and learning how information about crop pollination flows to growers (see the example inside). Last but not least, the modeling and economics group has been busy with developing their national view of wild bee abundance and crop pollination mismatches as well as early development of the pollination enhancement tool for growers. With another two years ahead on this project, there's so much more yet to come. We hope you enjoy this newsletter, and please visit our website at projecticp.org for more information.

Rufus Isaacs
Project Director
Michigan State University

USDA United States Department of Agriculture National Institute of Food and Agriculture

Project ICP: *Year 3 Snapshots*

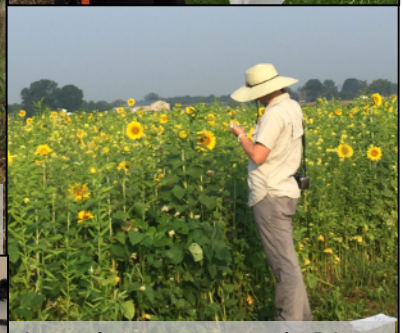
Michigan tree fruit field crew. © *K. Powers*

Seeding near a Florida blueberry field. © *E. May*

Sampling bees on blueberry in British Columbia. © *E. Elle*

Solarization for weed control in California almond. © *K. Ullmann*

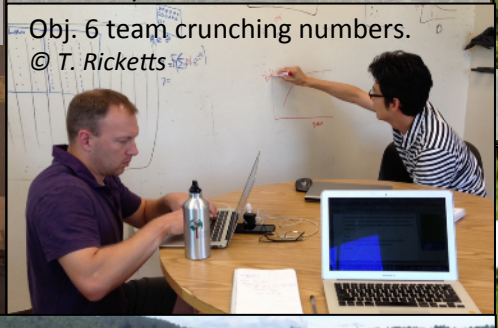
Managing weeds in Oregon blueberry. © *K. Ullmann*



Assessing cover crops in PA pumpkin. © *E. Treanore*

Surveying MI blueberry growers at ICP workshop. © *E. May*

Obj. 6 team crunching numbers. © *T. Ricketts*



Measuring cherry fruit set in WA. © *K. Allen*

Counting bees in OR blackberries. © *J. Cane*

Setting up bumble bee quads in MI blueberry. © *E. May*

Grower interview. © *R. Isaacs*

ICP researchers at ESA 2015. © *L. Mason*

Measuring floral abundance in California. © *K. Ullmann*

Peerbolt Crop Management

Caneberry field with Mt. St. Helens in the background. Photo courtesy of Anna Peerbolt

At Peerbolt Crop Management (PCM) we have been working with berry growers in Oregon and Washington since 1994. The services have evolved from providing in-field monitoring for growers, with faxed findings and suggestions, to on-line interactive reports with dynamic maps of their fields. The company also offers a range of consulting services. We are active in research, with multi-year in-field variety trials of caneberries, as well as partnering with other researchers on grants ranging from biological control of leafrollers to identification of *Phytophthora*, and weevil management. Over the past seven years, PCM has been involved in area-wide monitoring for spotted wing *Drosophila* (SWD) in strawberries, caneberries and blueberries. We also offer third-party certification for exported blueberries.

In 2014 the company created a nonprofit corporation, Northwest Berry Foundation, to handle the many industry services created by PCM. These include: a berry donation program, writing and disseminating the weekly Small Fruit Update to 1,200 subscribers; an annual pre-production workshop for caneberry growers; strawberry workshops that bring growers and suppliers together, twice-monthly bulletins, and taste testing to encourage fresh strawberry acreage. The website, www.berriesnw.com, provides up-to-date information including: an industry calendar, a searchable pesticide chart, and a searchable insect and disease database with rich content and diagnostic photographs.

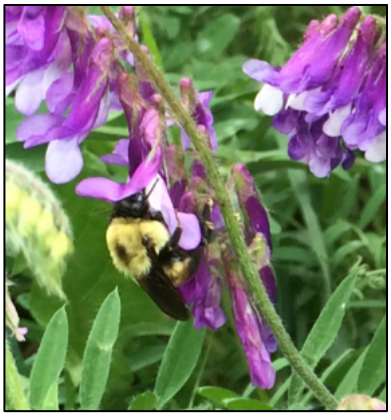
PCM scouts at work, Clockwise from top left). Assessing a blueberry field. Identifying spotted wing Drosophila from monitoring traps. Tom Peerbolt founder of PCM and Project ICP Advisor. Photos: Anna Peerbolt

For more information please visit:
www.peerbolt.com

Anna and Tom Peerbolt
Peerbolt Crop Management

Targeted Floral Provisioning in Cucurbits

Regardless of the local bee biodiversity, the common Eastern bumble bee (*Bombus impatiens*) and squash bees (*Peponapis pruinosa*) provide the overwhelming majority of visits to pumpkin flowers in northeastern states. Thus, for pollination services to pumpkin, we have been focusing on understanding the dynamics and conserving populations of these two species. Ensuring plentiful floral resources is one component. Squash bees are specialists, which limit opportunities for floral provisioning, but *B. impatiens* has a wonderfully complex life cycle with foraging life stages over a long seasonal timespan, and a very wide host range. We have been adapting floral resources for *B. impatiens* in wholesale direct-marketing pumpkin production system.



A bumble bee foraging on hairy vetch in a flowering cover crop mix.

Photo: Emily May

In our field observations, we see remarkably strong competition among plants for visitation by bumble bees. If thistle (*Cirsium* spp.) or horsenettle / nightshade (*Solanum* spp.) weeds are in bloom, we have a hard time collecting any *B. impatiens* from pumpkin blooms. For now we focused floral provisioning to minimize plant competition during mid-July to mid-August. Pumpkins flower over an extended season, but this production system places a heavy priority on blooms set close to the crown of the vine during mid-July to mid-August. The uniqueness of this

Penn State University graduate student Carley Miller assessing late summer cover crop mixes. Photo: Erin Treanore

production system on a larger scale also influenced our choice of floral species. All pumpkins are grown in extended (3+ years) rotation. For this wholesale system, this included rented fields in spatially disparate (up to 30 miles) clusters. To ensure resources in both spatial and temporal proximity to the crop, we focused on annual plant species. Pumpkins encompass diverse production systems: direct-retail operations will have a different phenology of pollination needs, and may rotate fields within a more localized farmscape, making perennial species more relevant.

For this ICP project, we are adapting cover crops to provide *B. impatiens* floral resources prior to mid-July and following mid-August. We are trialing seed mixtures, aiming for a sequence of resources utilized by *B. impatiens* that can be easily established with grain drills that exist on these farms, and prioritizing species with readily accessible and affordable seeds. We are hoping to provide resources synchronized with early establishment of *B. impatiens* colonies, ideally including resources for the overwintered queen, and resources for late-season colony development in hopes that it contributes to successful overwintering, while minimizing

Targeted Floral Provisioning in Cucurbits

plant competition during relevant pumpkin bloom.

We have trialed fall-planted, spring-blooming mixes, aimed at the early establishment of *B. impatiens* colonies. Early efforts included winter pea, crimson clover, hairy vetch, and canola, within an oats nurse crop to help with fall establishment. Initial results suggest that we can drop winter pea due to poor visitation rates, that it helps to utilize the early-blooming cultivars of hairy vetch (such as 'Purple Bounty'), and that the canola was more visited by honey bees than bumble bees.

Although hit twice by severe 'polar vortex' winters, we also are seeing the potential of pushing the northern limit of crimson clover, perhaps because of the oats nurse crop. We have been encouraged by the visitation of overwintered queens, and by the timing of senescence of these mixes in our landscapes, which help avoid competition with pumpkin bloom. To follow pumpkin bloom, we've trialed summer-planted, fall-flowering mixes, aimed at bolstering *B. impatiens* prior to overwintering.

Progression of floral resources through the summer. Buckwheat and mustard bloom early (left) and give way to sunflowers later (right). Photo K. Watrous

Early efforts included buckwheat, white mustard, *Phacelia*, sunflower, sunn hemp, and cowpeas, planted in July and flowering from mid-August until frost. Initial results suggest that we can drop cowpeas due to poor visitation rates, and that *Phacelia* is not successful when planted in a mix. Mustard was visited more by honey bees than *Bombus*. Both buckwheat and sunflower worked well, but sunn hemp varied by location. We ran into logistic constraints associated with the timing of planting, farm labor, and availability of land due to timing of harvest or senescence of other crops. Inter-seeding into standing crops, being developed for field crops, may offer solutions.

We believe we can optimize the goal of using cover crops to achieving floral resources for bees, targeted to early and late season bumble bee colony life cycles, in our pumpkin production systems. Growers certainly have been receptive, taking preliminary suggestions and trialing it on their farms. Proving an economic benefit to pumpkin yield does not seem to be a constraint – the rationale of conserving a valued ecosystem service has been sufficient. What we need now are clear guidelines of what to plant, when, in what mix, at what seeding rate, for what climatic zone, at what seeding rate, using what fertility and termination practices, how to buffer these choices to meet the variation of a given season, and how this influences bumble bee colony health. With this information, adoption of cover crops could be quite rapid in our production areas.

Shelby Fleischer, Carley Miller, Erin Treanore, Kristal Watrous
Pennsylvania State University

Grower Spotlight: Jeff & Nita Send

"We need bees … we don't want to lose them."

Project ICP is sampling 148 crop fields around the country to assess how best to integrate multiple pollination strategies on farms. This work involves coordinating with farm partners – including Jeff and Nita Send of **Cherry Lane Farms**.

The Sends, who grow 800 acres of tart and sweet cherries in northern Michigan, the largest tart cherry production region in the United States, are working with researchers at MSU to find new ways to support bees on their farm. While the majority of Michigan tart cherry growers use honey bees to pollinate their crop, some growers, like the Sends, are using an alternative managed bee called the horn-faced bee (*Osmia corniforns*) and wild bees in addition to the honey bees they rent.

Jeff Send grew up working on his grandfather's 40-acre farm and orchard. Jeff recalls that as a child he remembers seeing a lot of wild bees and then, at some point, there were less. He says, "Now, I think the wild bees are coming back." "Slowly," adds Nita Send.

Over the past three years, MSU researchers have found 81 different species of wild bees, in addition to honey bees, visiting Michigan tart cherry during bloom.

The Sends collaborated with Project ICP researchers to seed a wildflower planting next to one of their orchards in 2013, which they hope will boost the populations of both wild and managed bees on their farm. The wildflower mix, designed to bloom outside of cherry bloom, provides pollen, nectar, and nesting sites for wild bees. "I think it's a great combination…maybe we'll recapture more of our wild bees," says Jeff Send.

In addition to planting wildflowers, the Sends modify their spray program in order to minimize any negative impacts on bees. "Bees are #1; when they're out there, we stay away," says Jeff. "You want to be aware of what you're spraying on those trees [and] when you're spraying it on the trees." For more information on how to protect bees from pesticides during bloom read this MSU extension article.

The Project ICP research team collecting bees visiting cherry flowers next to a newly-seeded wildflower planting at Send Orchards in May 2015. Photo: Julianna Wilson.

Katharina Ullmann
The Xerces Society for Invertebrate Conservation

Florida Blueberry Pollination Management Summary

The Integrated Crop Pollination Project (ICP) is studying specialty crop pollination in blueberries and other high value crops around the country. As part of this project, we are working to understand how farmers are currently meeting their crop pollination needs. This survey, which was administered by the National Agricultural Statistics Service and conducted by phone, focused on blueberry growers in five counties in Florida—Alachua, Jackson, Lake, Marion, and Polk—to better understand growers' practices and management priorities related to crop pollination.

Overview of FL blueberry farms

We received 69 complete responses from FL blueberry growers (70% return rate) with information about the 2014 growing season. The growers in Florida represent average acreage and farm sizes reported in the 2012 Agricultural Census for focal counties (Table below).

	Ag. Census 2012	ICP Survey 2014-15			
County	Farm size* *acres*	Farm size *acres*	Blueberry *acres*	# of farms	Buy/rent pollinators
Alachua	113	47.8	6.4	21	33%
Jackson	226	164.1	0.6	5	0%
Lake	85	699.5	5.4	7	57%
Marion	83	115.3	2.8	12	25%
Polk	216	63.5	38.2	24	61%
Mean	**144.6**			**Total = 69**	**42%**

*Average farm size acreage reported in 2012 Agricultural Census, data available online: http://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Florida

Integrated Crop Pollination Project

Integrated crop pollination (ICP) is the combined use of multiple pollinator species, habitat augmentation, and farm management practices to provide reliable and economical crop pollination.

The Integrated Crop Pollination project team is studying integrated crop pollination in a number of specialty crops around the country.

For more information, visit our website at: www.projecticp.org
Or find us on Facebook. This project is funded by a USDA-NIFA Specialty Crop Research Initiative Grant (Award #2012-51-181-20105).

For ICP survey details, contact:
Dr. Kelly Garbach
kgarbach@luc.edu
P# (773) 508-2948

Pollinator management context

Forty-two percent of FL blueberry growers reported buying or renting bees annually. Among growers that do not buy or rent pollinators, most rely on wild pollinators (70%); some growers rely on bees sourced by neighbors (11%), use bees that they own (8%), or use other strategies (<5%).

Blueberry growers reported buying/renting pollinators more frequently than other FL crop growers, as did growers on larger farms (crop type, $X^2 = 20.7$, df = 2, p = 0.0001; farm size $X^2 = 15.6$, df = 3, p = 0.0004).

Honey bees are the most frequently used managed pollinators. Photo: Emily May.

Use of managed and wild pollinators

Florida blueberry growers often use honey bees (51%), with 12% of growers reporting bumble bees as their primary pollinator; 37% reported using a combination of honey bees and bumblebees, or honey bees and wild bees. Other pollinators can also be managed for crop pollination.

Management practices

The ICP survey asked growers about their management practices, including pollination and pest management practices that are currently used, those that were tried in the past but discontinued, and practices that had never been used (Figure 2: current practices in solid bars, past practices in striped bars, practices never used in open bars).

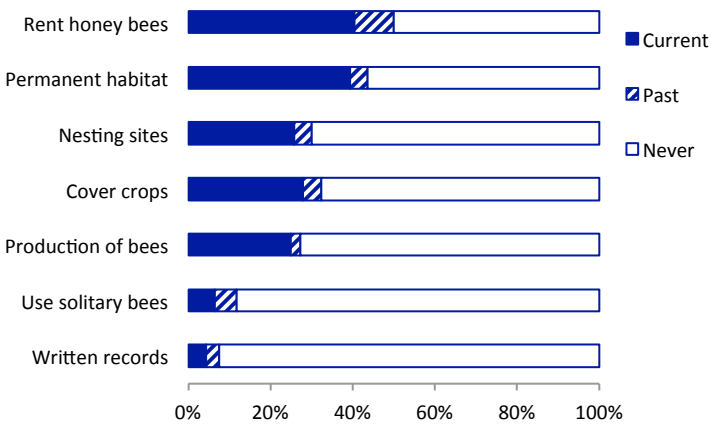


Figure 1: Pollination management practices

Honey bees: Renting managed honeybees is the most frequently reported current management practice (40% of blueberry growers).

Pollinator habitat: Practices of using habitat to attract and retain diverse pollinators had intermediate levels of adoption: 28% of growers encouraged pollinators using temporary cover crops, 26% report creating bee nesting sites (e.g., installing bee boxes or leaving areas of reduced tillage), and 39% of growers report encouraging pollinators with areas of permanent habitat. Permanent habitat should likely be interpreted as retaining existing habitat rather than activities of "creation or restoration" of permanent habitat, as it includes maintaining wooded areas, old fields, and other semi-natural areas adjacent to cropped areas .

Management priorities & knowledge

The ICP Survey asked growers about management priorities, and asked growers to rank whether considerations were Always, Often, Sometimes, or Never priorities. Taken together, the data suggest that consistent, reliable crop pollination represented is a top tier priority (Figure 2).

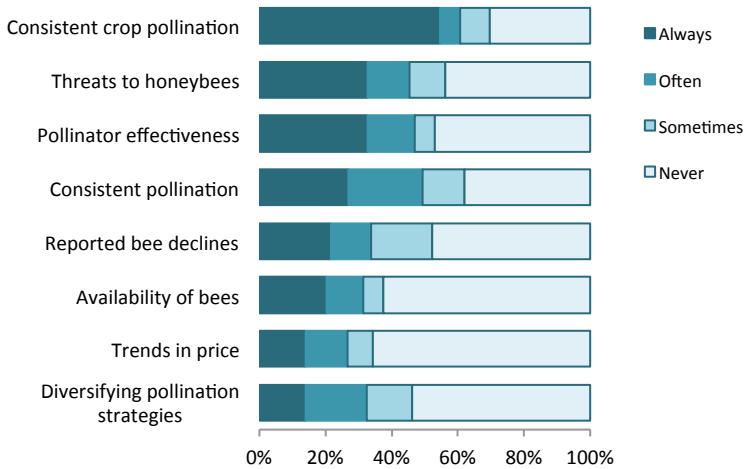


Figure 2: Pollination management priorities

The ICP survey also investigated patterns of communication relevant to pollination management (Figure 3).

Grower-to-grower communication, as well as working with extension specialists and beekeepers is critical to informing pollination management for FL blueberry growers.

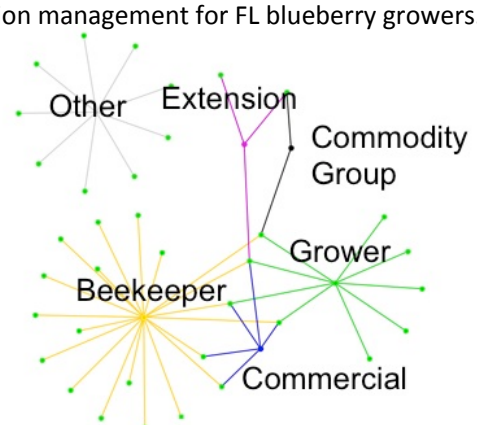


Figure 3: Knowledge Networks

Kelly Garbach
Loyola University - Chicago

2015 ICP Pollination Workshops

Project Director Rufus Isaacs (MSU) presents at an ICP-led blueberry pollination workshop in southwest Michigan in Nov. 2015. Photo: Emily May.

The Project ICP Education and Outreach team began its ongoing series of grower-focused pollination workshops with two workshops in Michigan and Florida blueberries in fall 2015.

The workshops, which included presentations from the ICP research teams at Michigan State University and University of Florida, respectively, focused on the concept of integrated crop pollination and introduced growers to the common crop pollinators of local blueberries. Both workshops included research updates from the project and talks on the best management practices for supporting bees on blueberry farms. Growers received hands-on instruction in identifying honey bees and common wild bees that pollinate blueberry.

Obj. 5 lead Kelly Garbach (Loyola University Chicago) was on hand for both workshops to collect grower feedback and perspectives, which will be analyzed against the Obj. 5 NASS survey data from the same counties.

Workshops and field days will continue in 2016, including events focused on Oregon blueberries, Pennsylvania pumpkin, and California almonds.

Emily May
The Xerces Society for
Invertebrate Conservation

Research technician Mary Bammer (UF) presents at an ICP-led blueberry pollination workshop in central Florida in Dec. 2015. Photo: Emily May.

ICP Team Sharpens Molecular Analysis Skills

In February 2015, Project ICP team members plus a few guests attended the first Bee Molecular Methods Workshop in Logan, Utah to spend a week learning about the background, theory and application of microsatellite analysis to bee ecological research.

Project Director Rufus Isaacs (MSU) pipettes at the February 2015 ICP Molecular Workshop in Logan, UT, as graduate student Carley Miller (PSU) looks on. Photo: Jason Gibbs.

The costs for the workshop were supported by Project ICP and we had a group of 12 trainees consisting of undergraduates to professors from eight universities in the United States and Canada. The four day workshop combined lectures with hands-on experience with PCR (Polymerase Chain Reaction) of bumble bee DNA extracted from legs, interpreting sequence data, and analysis of the outputs. This allows for determination of the relatedness of individual bumble bee workers and whether they come from the same or different colonies. This molecular analysis approach has various other applications, but is being specifically applied in this project to assess the number of bumble bee colonies that are sending worker bees to crop fields, and to determine whether wildflower or cover crop plantings are increasing the density of bumble bee populations.

The workshop was organized and hosted by Dr. Jamie Strange's lab at the USDA-ARS Pollinating Insects Research Unit and by Utah State University. The teaching was done by Strange along with post-doc Dr. Amber Tripodi and graduate student Jonathan Koch, with excellent technical support from Joyce Knoblett. We thank the whole team in Logan for their wonderful hospitality, as well as all their time to share their expertise with the workshop participants.

Rufus Isaacs
Michigan State University

Natalie Boyle — USDA-ARS, Logan, UT

Dr. Natalie Boyle is a recent graduate from the Department of Entomology at Washington State University in Pullman, WA. She earned her master's degree in 2012 under the advisement of Dr. Steve Sheppard and received her PhD in 2015 from Dr. Doug Walsh's lab studying pollinator-mediated gene flow in alfalfa seed production.

Her research background includes direct experience working with honey bees, the alfalfa leafcutting bee, and the alkali bee in agricultural settings. Natalie is delighted to be joining the ICP team as a USDA postdoc in the Logan bee lab.

Josh Campbell — University of Florida

Dr. Joshua W. Campbell is a postdoctoral research associate at the University of Florida in the Honey Bee Research and Extension Lab (HBREL). He received his B.S. degrees in zoology/geology from Auburn University, M.S. degree in geoscience from University of Nebraska-Lincoln and his Ph.D in entomology from the University of Georgia.

At the University of Florida, his primary research focus deals with pollinating insects and how they are affected by human land use. He currently works on ICP (Integrated Crop Pollination), OP (Operation Pollinator), and a project testing a novel pesticide on honey bee health.

Emily May — Xerces Society

Emily May joined the Objective 4 (ICP outreach) team as a Pollinator Conservation Specialist for the Xerces Society for Invertebrate Conservation in May 2015. She received a B.A. in Environmental Studies/Biology from Middlebury College (VT) and an M.S. degree in Entomology from Michigan State University, where she worked with Rufus Isaacs. Her thesis research evaluated the effects of wildflower plantings and spray programs on wild bee communities in Michigan highbush blueberry. She is currently based at the University of Vermont.

The Integrated Crop Pollination Project 2015 Annual Meeting, UC Davis Photo: Kathy Keatley Garvey

The Project ICP Team met for its 3rd Annual Meeting at the University of California, Davis in January of 2015. This two day meeting was a chance for all the project participants to all be in one place to reconnect on the all the facets of our project. Our main goals were to review the 2014 field season, plan for the coming year of research and education activities and share ideas about how the activities and results of our project can best be used to help specialty crop growers.

After a good round of research reporting, smaller breakout groups were used to coordinate sampling protocols and data collection for each crop. Lively group discussions helped us plan out how to best assess habitat enhancements that have been planted as part of Project ICP, and generated new ideas for synthesis and analysis of data across our target crops and field research objectives. The group was also able to meet with the Project ICP Advisory Committee and received valuable feedback on how they see the project's progress, and future direction.

Between meeting sessions there was plenty of time for socializing and free-form brainstorming on what we should focus on in the next steps of our project, and what could be the next steps beyond Project ICP.

On the final afternoon of the meeting, the ICP group enjoyed a day trip to visit a Project ICP grower cooperator's watermelon farm, and we also had a short tour off-campus research sites where wildflower mixes and plot establishment methods are being tested.

We owe a great deal of thanks to Neal Williams and his lab for the fine job they did hosting our meeting. In fact, we enjoyed the meeting so much, that we will return to Davis to hold the 4th Annual Meeting of Project ICP in early 2016.

The ICP group visiting California wildflower plantings. Photo K. Mason

Keith Mason
Project ICP Manager
Michigan State University